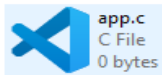


Report For

LAB 1

Using touch command at Git Bash to create files:



```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_E...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diplom
a/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ touch app.c uart.c uart.h

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diplom
a/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

Uart.c file:

```
1  #include "uart.h"
2  #include "platform_types.h"
3
4  #define UART0DR *((vuint32_t *)((vuint32_t *)0x101f1000))
5
6  void uart_send_string(uint8 *p_tx_string)
7  {
8      /* loop until end of string (null terminator)*/
9      while(*p_tx_string != '\0')
10     {
11         /* write character by character on uart */
12         UART0DR = (uint32)*p_tx_string;
13         /* point to next character */
14         p_tx_string++;
15     }
16 }
```

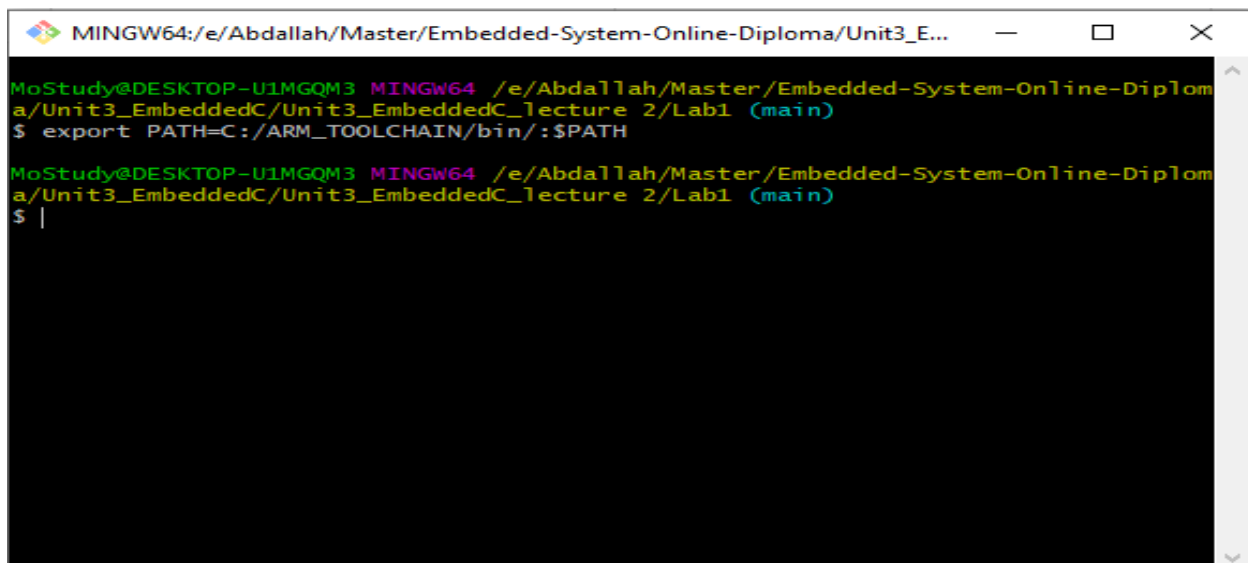
Uart.h file

```
1  #ifndef _UART_H_
2  #define _UART_H_
3  /* prototype */
4  void uart_send_string(uint8 *p_tx_string);
5
6  #endif
7
```

App.c file

```
1  #include "uart.h"
2  /* global array of char act as string holding our string which we need it to be written on uart */
3  uint8 stringBuffer[100] = "Learn-in-Depth: Mohamed Abdallah";
4  void main(void)
5  {
6      /* pass string to uart */
7      // name of array point to the address of first charater stringBuffer == &stringBuffer[0]
8      uart_send_string(stringBuffer);
9  }
```

Include ARM/bin directory to our project directory:



```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_E...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diplom
a/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ export PATH=C:/ARM_TOOLCHAIN/bin/:$PATH

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diplom
a/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

Obtain .o files (compile file but not link)

app.c
C File
395 bytes

uart.h
H File
136 bytes

app.o
O File
992 bytes

uart.o
O File
823 bytes

platform_Types.h
H File
1.17 KB

uart.c
C File
414 bytes

```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_Emb...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-gcc.exe -c -mcpu=arm926ej-s -I . app.c -o app.o

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-gcc.exe -c -mcpu=arm926ej-s -I . uart.c -o uart.o

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

To watch obj file sections

```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_Emb...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-objdump.exe -h app.o

app.o:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
  0 .text          00000018  00000000  00000000  00000034  2**2
    CONTENTS, ALLOC, LOAD, RELOC, READONLY, CODE
  1 .data          00000064  00000000  00000000  0000004c  2**2
    CONTENTS, ALLOC, LOAD, DATA
  2 .bss           00000000  00000000  00000000  000000b0  2**0
    ALLOC
  3 .comment       00000012  00000000  00000000  000000b0  2**0
    CONTENTS, READONLY
  4 .ARM.attributes 00000032  00000000  00000000  000000c2  2**0
    CONTENTS, READONLY

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

To generate assembly file from obj file (disassembler)



```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_Emb...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-objdump.exe -D app.o > app.s
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

To generate binary file from obj file



```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_Emb...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-objdump.exe -s app.o > app.bin
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

Startup.s file

```
1  .global reset
2  reset:
3      ldr sp, =stack_top
4      bl main
5  stop:
6      bl stop
```

To generate obj file from assembly file (assembler)

app.bin
BIN File
1.05 KB

platform_Types.h
H File
1.17 KB

uart.h
H File
136 bytes

app.c
C File
395 bytes

startup.o
O File
696 bytes

uart.o
O File
823 bytes

app.o
O File
992 bytes

startup.s
S File
79 bytes

app.s
S File
1.63 KB

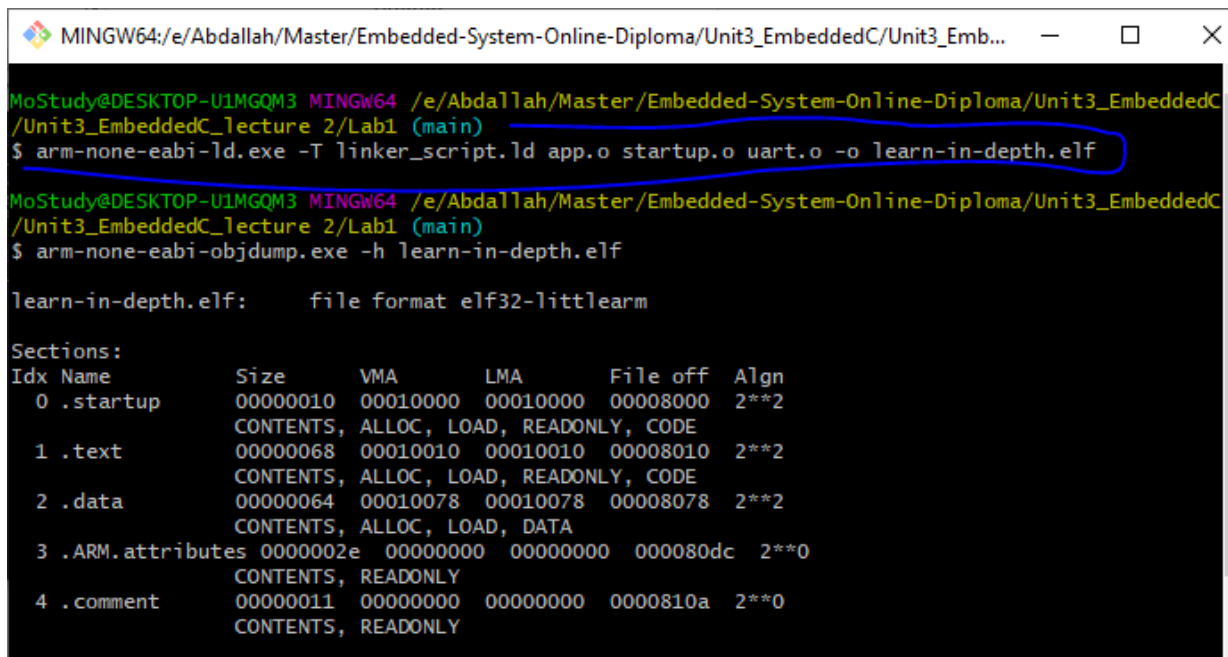
uart.c
C File
414 bytes

```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_Emb...
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-as.exe -mcpu=arm926ej-s startup.s -o startup.o
startup.s: Assembler messages:
startup.s: Warning: end of file not at end of a line; newline inserted
MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC
/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

Linker script.ld

```
1 ENTRY(reset)
2
3 MEMORY
4 {
5     Mem(rwx): ORIGIN = 0x00000000, LENGTH = 64M
6 }
7
8 SECTIONS
9 {
10     . = 0x10000;
11     .startup . :
12     {
13         /* take only .text part from startup.o and let it appear in new section name (.startup)*/
14         startup.o(.text)
15     }> Mem
16     .text :
17     {
18         /* take all remain .text from all other files and let it appear section name (.text)*/
19         *(.text)
20     }> Mem
21     .data :
22     {
23         *(.data)
24     }> Mem
25     .bss :
26     {
27         *(.bss)
28     }> Mem
29     . = . + 0x1000;
30     stack_top = .;
31 }
```

To link files together



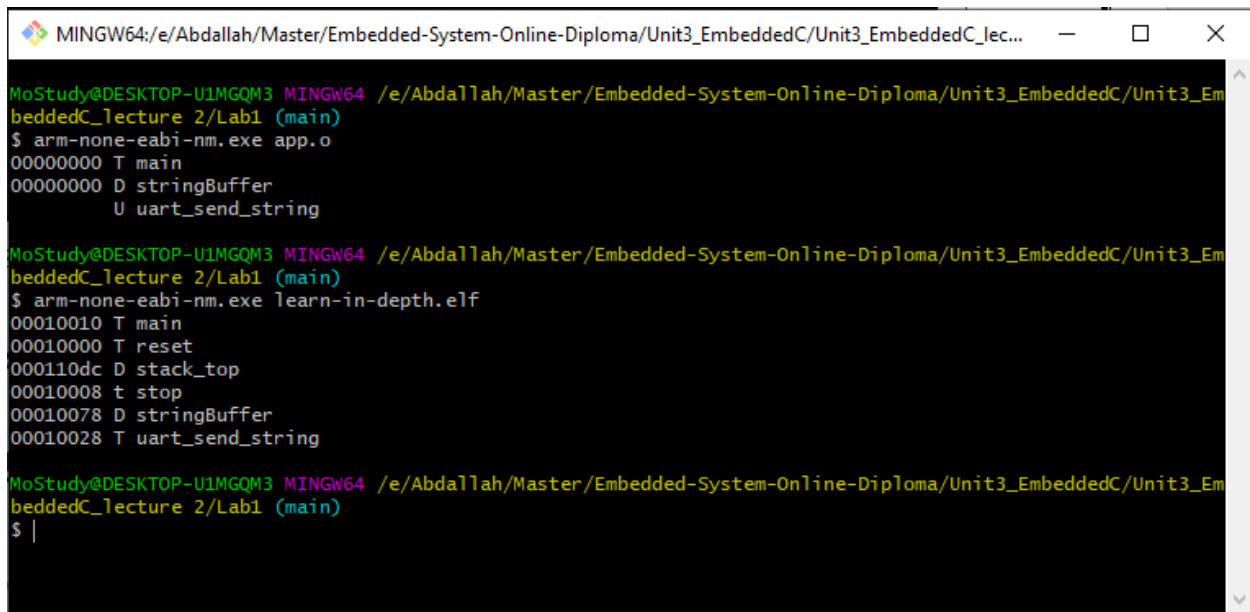
```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-ld.exe -T linker_script.ld app.o startup.o uart.o -o learn-in-depth.elf

MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-objdump.exe -h learn-in-depth.elf

learn-in-depth.elf:      file format elf32-littlearm

Sections:
Idx Name          Size      VMA       LMA       File off  Algn
 0 .startup        00000010  00010000  00010000  00008000  2**2
   CONTENTS, ALLOC, LOAD, READONLY, CODE
 1 .text           00000068  00010010  00010010  00008010  2**2
   CONTENTS, ALLOC, LOAD, READONLY, CODE
 2 .data           00000064  00010078  00010078  00008078  2**2
   CONTENTS, ALLOC, LOAD, DATA
 3 .ARM.attributes 0000002e  00000000  00000000  000080dc  2**0
   CONTENTS, READONLY
 4 .comment         00000011  00000000  00000000  0000810a  2**0
   CONTENTS, READONLY
```

To read the symbols



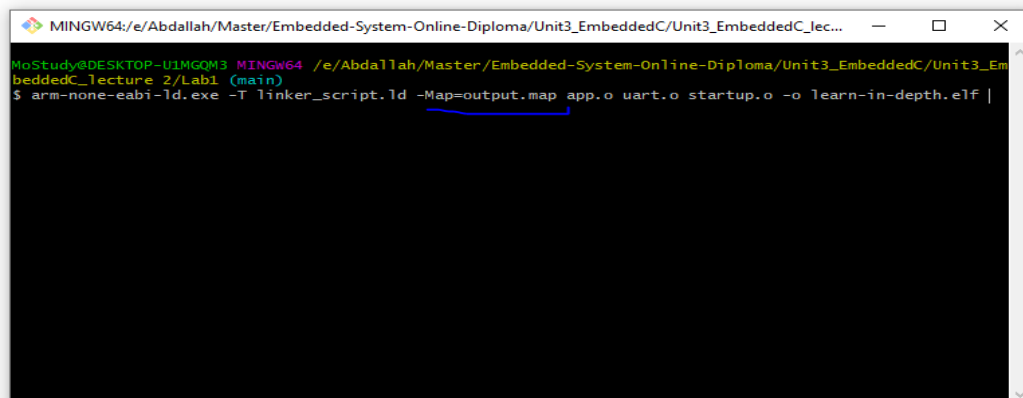
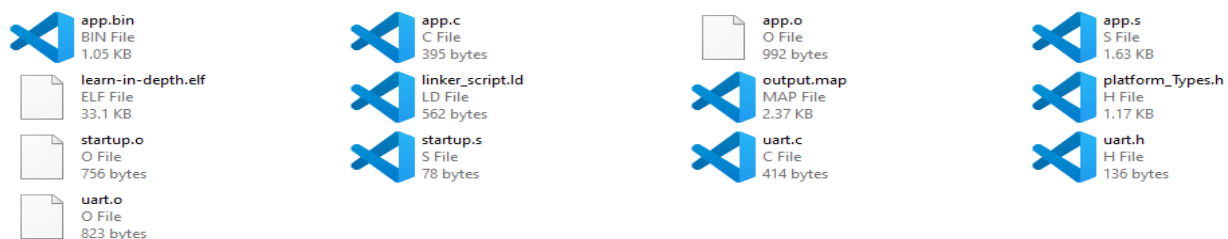
```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture_2/Lab1 (main)
$ arm-none-eabi-nm.exe app.o
00000000 T main
00000000 D stringBuffer
U uart_send_string

MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture_2/Lab1 (main)
$ arm-none-eabi-nm.exe learn-in-depth.elf
00010010 T main
00010000 T reset
000110dc D stack_top
00010008 t stop
00010078 D stringBuffer
00010028 T uart_send_string

MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture_2/Lab1 (main)
$ |
```

- T : text section.
- D : data section.
- U : unresolved.

Information about memory layout in details



```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture_2/Lab1 (main)
$ arm-none-eabi-ld.exe -T linker_script.ld -Map=output.map app.o uart.o startup.o -o learn-in-depth.elf |
```


Getting binary from .elf to run it

app.bin
BIN File
1.05 KB

learn-in-depth.bin
BIN File
220 bytes

platform_Types.h
H File
1.17 KB

uart.h
H File
136 bytes

app.c
C File
395 bytes

learn-in-depth.elf
ELF File
33.1 KB

startup.o
O File
756 bytes

uart.o
O File
823 bytes

app.o
O File
992 bytes

linker_script.ld
LD File
562 bytes

startup.s
S File
78 bytes

app.s
S File
1.63 KB

output.map
MAP File
2.37 KB

uart.c
C File
414 bytes

```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ arm-none-eabi-objcopy.exe -O binary learn-in-depth.elf learn-in-depth.bin

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ |
```

Output

```
MINGW64:/e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ ls ../../../../
README.md  Unit3_EmbeddedC/  unit2_C_Programming/

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ ls ../../../../
Embedded-System-Online-Diploma/  'New folder'/  mix/  qemu/  units/

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ ls ../../../../qemu/qemu-system-arm -M versatilepb -m 128M -nographic -kernel learn-in-depth.bin
ls: unknown option -- M
Try 'ls --help' for more information.

MoStudy@DESKTOP-U1MGQM3 MINGW64 /e/Abdallah/Master/Embedded-System-Online-Diploma/Unit3_EmbeddedC/Unit3_EmbeddedC_lecture 2/Lab1 (main)
$ ../../../../qemu/qemu-system-arm -M versatilepb -m 128M -nographic -kernel learn-in-depth.bin
dsound: Could not initialize DirectSoundCapture
dsound: Reason: No sound driver is available for use, or the given GUID is not a valid DirectSound device ID
Learn-in-Depth: Mohamed Abdallah
```